

## Productivity Growth

News about economic issues focuses on topics such as inflation, international competitiveness, standards of living, and long-run demographic challenges. Productivity growth rarely makes the headlines. Why is productivity growth important to the nation? Because higher productivity growth improves the outlook for all of these issues. It helps keep inflation in check, makes it easier for American businesses and workers to compete, raises standards of living, and reduces the difficulty of meeting long-run demographic challenges by increasing the total amount of resources available.

Over the past 10 years, gross domestic product (GDP) per capita has grown faster in the United States than in almost every other advanced industrialized country. The United States owes its recent strong per capita growth in large part to strong labor productivity growth. A continuation of this productivity growth is essential to increasing real wages and maintaining the high standard of living in the United States.

To remain competitive, U.S. businesses must hold costs down by getting the most out of the inputs they use—that is, they must increase labor productivity. Similarly, for U.S. workers to earn higher wages than workers in other countries while competing in a global economy, U.S. labor productivity must exceed that of lower-wage countries.

Labor productivity growth also holds the key to dealing with the economic and fiscal challenges of a rapidly aging population. The total amount of goods and services produced in a country, measured by GDP, can grow only if productivity or hours of work increase. As the baby boomers (those born between 1946 and 1964) reach retirement, growth in total hours of work across the U.S. economy will slow, and the United States will have to depend increasingly on productivity growth to drive increases in GDP. While labor force growth will slow, the elderly population will expand relatively quickly. Strong GDP growth must continue in order to maintain the standards of living for both the working age and the dependent populations.

The amount that U.S. workers produce has grown at remarkable rates in recent years. Since 1995, productivity growth has averaged over 2.5 percent per year, compared to an average growth rate of about 1.4 percent per year over the preceding 20 years. Most other major industrialized countries suffered a slowdown in productivity growth between 2000 and 2005, but in the United States, growth accelerated to about 3 percent, the fastest productivity growth of any G7 country—Canada, France, Germany, Italy, Japan, the

United Kingdom, and the United States—over that period. Given that the United States’ productivity was already among the highest and that these countries have similar access to technological improvements and financial markets, the sudden increase in U.S. productivity growth relative to other developed countries is especially impressive.

Table 2-1 illustrates how small differences in productivity growth rates can, over time, have large effects on the level of productivity and hence on the standard of living. When productivity doubles, twice as much output can be produced using the same level of labor. The table lists four different productivity growth rates that correspond to averages for different U.S. historical time periods, along with the number of years it would take to double the standard of living at that rate of growth. If productivity continues to grow at the rate from the most recent period (3.1 percent), the U.S. standard of living will double in about 23 years; at the slower productivity growth rate experienced during the 1973–1995 period (1.4 percent), doubling would take more than twice as long.

TABLE 2-1.—*Implied Doubling Rates for the Level of Productivity Using Historical Growth Rates*

	Productivity growth rate	Doubling time (in years)
1950 to 1973 .....	2.6%	27.0
1973 to 1995 .....	1.4%	49.9
1995 to 2000 .....	2.5%	28.1
2000 to 2005 .....	3.1%	22.7

Source: Department Labor (Bureau of Labor Statistics), Council of Economic Advisers calculations.

This chapter reviews the sources of the recent strength in productivity growth, highlighting the role that flexible markets and entrepreneurship play in explaining cross-country differences. It also explains the benefits of productivity growth and discusses how policymakers can further promote it. Key points are:

- Recent productivity growth has been primarily driven by *efficiency growth* (growth in how well labor and capital inputs are used) and by *capital deepening* (growth in the amount of capital that workers have available for use).
- Efficiency growth comes from developing new methods of production and new products. Entrepreneurship and competition make key contributions to such innovation.
- Investment in information technology (IT) capital and innovative new ways of using it have been important sources of productivity growth in many industries with particularly high growth rates.

- Openness to international trade and investment is especially important for fostering competition and thus productivity growth.
- Increases in the education and training of the U.S. workforce have been and will continue to be important to long-run productivity growth.
- Policies that encourage capital accumulation, research and development, and increases in the quality of our educational system can boost productivity growth over the long run.

## The Basics of Productivity Growth: Framework and Recent Facts

*Labor productivity* measures the goods and services produced per hour of work. In the United States, the most commonly used measure of labor productivity is that for the nonfarm business sector, which excludes all levels of government, nonprofit institutions, households, and farms. Because output from nonbusiness entities is particularly difficult to measure, nonfarm business labor productivity is thought to best measure how labor productivity varies over time. For international comparisons of productivity, total output per hour worked is often used because data on hours by sector are not always readily available.

### Factors That Increase Labor Productivity

What increases labor productivity? Research on this question usually divides changes in labor productivity into three sources: capital deepening, increases in skill, and efficiency gains.

#### *Capital Deepening*

Capital deepening happens when businesses invest in more or better machinery, equipment, and structures, all of which make it possible for their employees to produce more. Matching employees with better capital increases the number of goods employees produce in each hour they work. Examples of capital deepening include the purchase of more sophisticated machine tools for workers in the manufacturing sector, or a faster computer system for a travel agent. A business may add capital when it increases its workforce—for example, a travel agency might buy additional computers when increasing the number of travel agents it employs—but that does not constitute capital deepening if the amount of capital available *per worker* does not increase.

Farming provides a classic example of the benefits of using more and better capital. In 1830, it took a farmer 250 to 300 hours of work to produce 100 bushels of wheat; in 1890, with the help of a horse-drawn machine, the

time dropped to between 40 and 50 hours; in 1975, with the use of large tractors and combines, the 100 bushels could be produced in just 3 to 4 hours. While it is most likely that farmers were more educated in 1975 than they were in the 1830s, the change in the farmers' skills alone could not be the source of this dramatic efficiency gain; an important source is the use of better capital. Changing from a hoe to the tractor would be categorized as capital deepening, and the resulting increase in output is capital deepening's contribution to productivity growth.

### *Increases in Skill*

Just as a worker who is paired with a better machine can produce more goods, a worker who learns a skill needed for production can produce more output in less time. For example, a worker who takes a class on how to use a computer increases the skill with which she uses the computer; the computer is no faster, but the worker's increased skill increases her output per hour worked and hence boosts her productivity. Workers increase their skills through additional education, training, on-the-job experience, and so on.

### *Efficiency Gains*

Businesses achieve efficiency gains—more output with the same amount of input—when they devise better ways of organizing and using the equipment they own and the people they employ. Efficiency gains include both *process innovations*, which increase productivity by reducing the capital or labor needed to produce a unit of output, and *product innovations*, which increase productivity by increasing the value of output. For example, when Henry Ford began mass-producing Model T's, the Model T itself was a product innovation, while the moving assembly line was a process innovation. The combination of improved process and product allowed the Ford Motor Company to reduce its production costs and become more competitive.

A more recent example of process improvements that led to direct efficiency gains may also be helpful in illustrating this concept. Managers at a 3M tape-manufacturing plant increased productivity by reorganizing part of their production process. By moving machines such as glue coaters and tape slitters closer to the packing equipment and robotic transporters, 3M substantially increased labor productivity at its plant. The reorganization reduced the need to move output around the plant, and cut the length of the production cycle. In addition, with all the packing supplies located in one place, managers could see when they had more than they needed and could cut costs by reducing excess inventories of supplies. This improvement is an efficiency gain because the plant produced more output without increasing capital or labor. This example is typical of the innovative process: companies purchase and install new machines—from computers to conveyor belts—but it takes time and further innovation to learn how to take full advantage of the new machines.

*Entrepreneurship* (developing new ways of doing business and making risky investments to implement them) and competition partially determine the degree to which innovation contributes to labor productivity. If a business comes up with a new product or a new way of organizing production and spends the resources to try it out, and if the new way improves on the old, the business ends up with a higher level of profit and an incentive to expand. Innovation by one business is likely to have little direct effect on a nation's productivity growth, but competition forces other businesses to either come up with innovations of their own or to cede market share. When this happens, capital investment and labor flow to businesses with better methods of production, and productivity increases as a result.

Entrepreneurship occurs on both small and large scales; many large multinationals spend large sums on research and development in order to innovate and expand, but individual entrepreneurs who operate on a small scale may also innovate. The entry and growth of new businesses, combined with the exit of older, less productive businesses, has been found to be responsible for a substantial share of efficiency growth.

## Productivity Growth in Recent Years

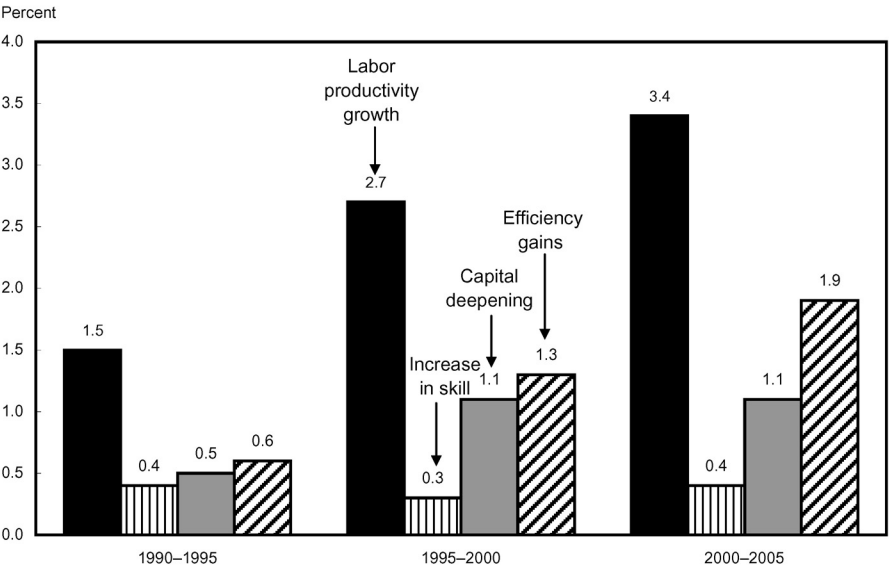
Chart 2-1 illustrates how increases in skill, capital deepening, and efficiency gains have contributed to productivity growth in recent years. It is important to note that the relative sizes of these contributions are only approximate and that some increases in the quality of labor and capital may be counted as efficiency gains. For example, economists can accurately measure education levels of the labor force, but on-the-job training is also commonplace and measuring the impact of this training on skill levels is difficult. Similar issues arise in adjusting for the quality of capital, particularly during periods of rapid technological changes. The net result is likely an understatement of skill increases and capital deepening, and a resulting overstatement of efficiency gains.

Chart 2-1 contrasts three periods, 1990–1995 (when U.S. productivity growth was relatively slow), 1995–2000 (when the pace of productivity growth quickened), and 2000–2005 (shows the most recent growth rate). Over these 15 years, skill increased at a fairly steady pace of about 0.3 percent to 0.4 percent per year. The sources of this increase are increased rates of college attendance and the increased experience of the workforce. Increases in skill have been an important source of long-run increases in labor productivity, and help explain why the United States has high income levels relative to other countries. Continuing a steady increase in skill is vital to maintaining solid productivity growth into the future, a topic discussed at more length in Chapter 2 of the 2006 Economic Report of the President.

But even when educational attainment among the young rises substantially, the skill level of the workforce as a whole evolves slowly. Because skill has

Chart 2-1 **Sources of Labor Productivity Growth**

Capital deepening and efficiency gains account for the increase in productivity growth since 1995.



Note: Based on productivity for private business sector. Estimates reflect latest available data, which do not include benchmark GDP revisions for 2003–2005.

Source: Department of Labor (Bureau of Labor Statistics).

increased at a relatively steady rate, it cannot be the source of the recent acceleration in productivity growth. Instead, capital deepening and efficiency gains have been the key productivity-raising factors. Between 1995 and 2005, increases in the quality and quantity of the U.S. capital stock accounted for 1.1 percent per year in productivity growth in the United States, more than doubling the contribution of capital to productivity growth relative to the 1990 to 1995 period. The surge in productivity in the late 1990s resulted not just from a rapid increase in the number of machines used in U.S. production, but also from large quality improvements to the capital stock. Many of these improvements came from the revolution in information technology, which is commonly accepted as the initiating force behind the acceleration. But investment in IT capital alone was not the whole story. Firms needed to develop processes that best used the new capital. In many ways, the first increase in productivity growth (the higher growth rate between 1995 and 2000) was due to increased capital, while the second boost (in the period between 2000 and 2005) occurred as firms became better and better at using the new technology.

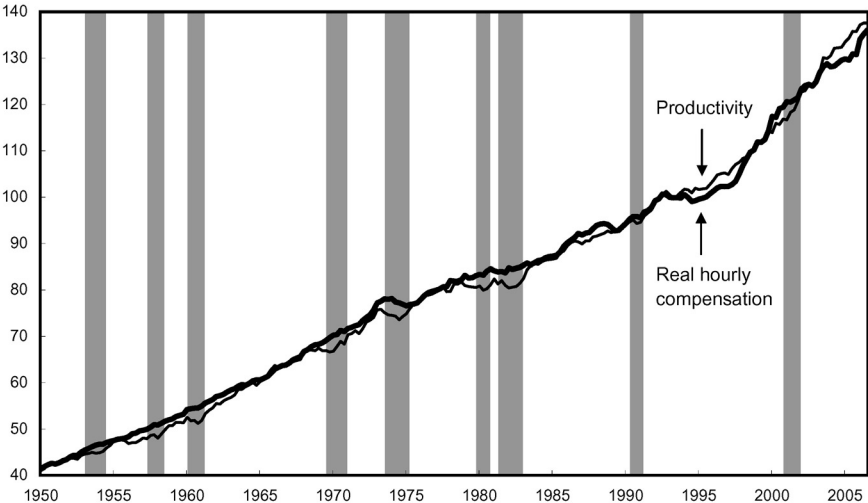
# Productivity Growth and Worker Earnings

The previous section looked at the sources of recent productivity gains, but did not discuss what productivity gains mean for a worker’s paycheck. This section examines how productivity growth affects average compensation and which groups have gained the most over time.

## Productivity and Average Earnings

The economic gains from productivity growth reach workers directly through growth in employee compensation, where compensation includes wages and the contributions that employers make for benefits such as health insurance and for government programs such as unemployment insurance and Social Security. Chart 2-2 shows that over long periods of time, productivity and real compensation grow at about the same rate. Real wages have grown somewhat more slowly than compensation and thus productivity over the last 20 years. The reason for this difference is that non-wage compensation, particularly employer contributions for health insurance, has accounted for an increasing share of compensation over this time period.

**Chart 2-2 Productivity and Real Compensation Grow Together**  
Productivity and compensation often diverge temporarily but grow together over the long run.  
Index 1992 = 100



Note: These data cover all persons (including supervisory workers and proprietors) in the nonfarm business sector. Real hourly compensation is hourly compensation deflated by the price deflator for nonfarm business output. Shaded areas denote recessions.  
Source: Department of Labor (Bureau of Labor Statistics).

Productivity growth is not a smooth process. Chart 2-2 shows that even in the recent time period, 1995 to 2005, when average productivity growth has been high, there are short periods of time where productivity growth appears to slow sharply or accelerate rapidly. Such changes in productivity growth are not uncommon. In addition, productivity sometimes grows faster than compensation, while sometimes compensation grows faster. Such short-term divergence in growth rates follows regular patterns and has been repeated many times. At times when productivity growth is particularly high, compensation growth tends to lag behind for a period of time before catching back up.

Why does compensation tend to lag behind productivity growth? When productivity growth is high, economic growth can happen without substantial employment growth. In other words, as productivity grows, businesses are able to expand output in response to increased demand without hiring more workers; the efficiency gains imply that each individual worker produces more output in the same amount of time. As the economy continues to expand, businesses once again begin to hire new employees, and the increased demand for workers begins to push up wages and compensation. Increased demand for workers leads to a period in which compensation growth exceeds productivity growth, and the two variables then converge for a while.

When productivity grows faster than compensation, businesses' profits tend to rise because the value of the goods and services they sell rises faster than their payroll costs. As a result, profits tend to rise during periods of rapid productivity growth. As tight labor markets bid up employee compensation, the increase in labor costs cuts into profits, and profits return to normal levels. In this process, profits vary more dramatically than employee compensation, falling much more sharply during recessions and then growing much more quickly in the early parts of the recovery. Because profits represent returns to earlier investments, very high profits in some years may not represent unusually large returns on investment because they may be offset by years of losses or unusually small profits.

## Productivity and Income Differences

The productivity and compensation numbers used in this chapter describe averages, but over the last 30 years, the economic gains for some groups have not kept up with those averages, while the gains for other groups have been well above the average. These uneven gains have led to growing disparity (or inequality) in compensation and wages. The same competition for workers that makes average employee compensation track productivity growth over the long term will occur for particular groups of employees within the overall labor force. The compensation for groups whose productivity has increased relative to the rest of the labor force will increase relative to average compensation. A number of studies have shown that factors associated with higher



productivity—such as education and work experience—have also been increasingly associated with higher wages. This is consistent with the view that growing compensation disparity has been driven by faster growth in productivity for skilled workers than for the less skilled.

In the 1980s, the increase in disparity was seen both in falling wages at the bottom of the wage distribution and rising wages at the top. Since then, wages in the bottom half of the distribution have either been flat or have grown modestly while disparity has continued to increase in the upper part of the distribution. For example, between 1990 and 2005 the wage at the 10th percentile grew 13 percent while the median wage grew 10 percent, so the difference between them narrowed somewhat. The wage at the 90th percentile of the distribution grew 18 percent over that period, widening the gap between the upper tail of the distribution and the median.

Why have wage levels grown increasingly disparate? Changes in technology that increase the productivity advantages associated with skill—often termed skill-biased technical change—appear to be the most likely cause. That is, technological advances increased the productivity of skilled workers more than the productivity of the less skilled, leading employers to want to hire more skilled workers. In doing so, employers bid up the wages of skilled workers, widening the difference in pay associated with skill.

Why does skill-biased technical change appear to be the most reasonable explanation for this trend? The main reason is that the price that employers pay for skilled workers trended upward even while the supply of skilled workers continued to grow. For example, although the fraction of the workforce that is college educated has grown consistently over the past 30 years (an increase in supply), the additional wages needed for an employer to hire a college-educated worker have also grown (an increase in price). Absent a shift in demand, increases in supply should drive down prices, so a price increase implies that demand has shifted toward skilled workers as well.

Do improvements in the way goods and services are produced necessarily lead to greater disparity in pay? If changes in technology have increased disparity, does that mean that technological change is always bad for those who are in the lower portion of the wage distribution? There are two reasons to doubt that this is true. First, economists studying earlier periods have found that wage disparity actually narrowed in the first half of the 20th century, providing evidence that, in some periods, change has favored less skilled workers as opposed to skilled workers.

A second and more fundamental reason that productivity growth does not leave a whole class of workers behind in the long run is that if changes in technology raise the pay of relatively skilled workers, they also increase people's incentives to invest in acquiring skills. Many of the factors that increase an individual worker's productivity depend on the worker's decisions to invest in

developing new skills. When the rewards to gaining skills increase, workers have increased incentive to acquire additional skills. For example, over the past 30 years, there has been a substantial widening in the difference between pay for workers with a bachelor's degree and pay for those with only a high school diploma. For men, this difference grew from 50 percent in 1975 to 87 percent in 2004.

If this widening in pay differences represents an increase in the amount a worker gains by getting a college education, then it gives individuals a greater incentive to make such an investment in education. Over the last 10 years, there has been an increase in the percentage of people who choose to go to college rather than enter the workforce directly out of high school. In 1992, the size of the workforce with some college education was roughly the same as the size of the workforce with a high school diploma or less. By 2006, the workforce with at least some college had become 50 percent larger than the workforce with no college. Other levels of education, such as master's and doctoral degrees, have shown similar increases in the rewards for obtaining such a degree and in the number of people choosing to make that investment. From 1987 to 2003, wages for those with an advanced degree increased faster than for those of any other education group, and since the mid-1990s, the share of people age 30–39 with an advanced degree has increased by 38 percent. Thus increased demand for skilled workers has been followed by an increase in supply, which raises the average skill level in the economy and leads to higher average productivity.

## Understanding the Acceleration in U.S. Productivity: Industry Analysis

Understanding why productivity growth in the United States has increased requires knowing what factors in the economy have changed. Chart 2-1 demonstrated that most of the recent increase came about through greater capital deepening and efficiency gains. What the chart did not tell us is why businesses increased their rates of capital investment to bring about capital deepening and why efficiency gains have been higher in the past decade than they were for much of the previous two decades.

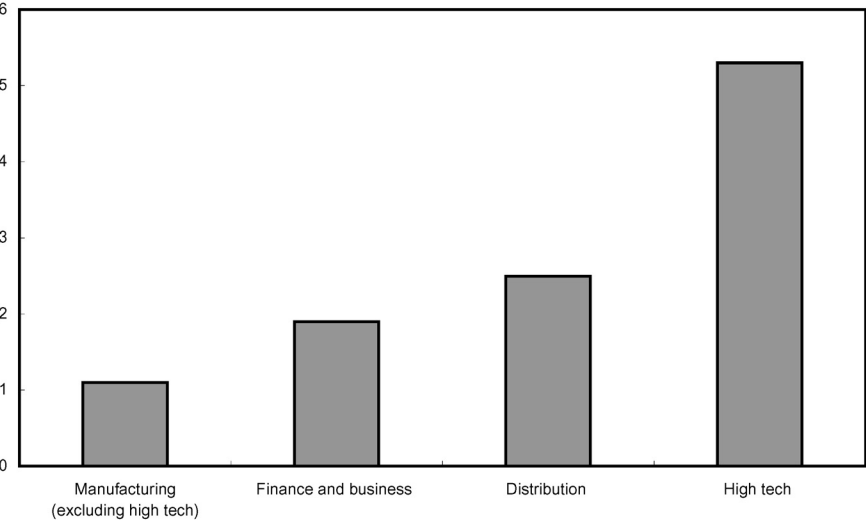
Productivity growth for the economy as a whole comes from investment and innovation in a wide variety of businesses. A lot can be learned about the sources of growth by looking at which kinds of investments have grown most quickly, as well as which industries have had the fastest productivity growth. The average rate of productivity growth hides substantial differences across industries. In particular, the surge in productivity in the late 1990s appears to be a story of growth in industries making and using IT capital. Chart 2-3

illustrates that efficiency growth since 2000 has been particularly strong in the high-tech sector, but that it has also been strong in the distribution sector, which includes retail and wholesale trade, transportation, and warehousing. Finance and business services also showed strong efficiency growth and hence strong productivity growth. Manufacturing, which has made small investments in IT capital compared to the other sectors shown, has had the slowest recent growth in efficiency.

The strong productivity growth in the distribution and financial services sectors highlights one of the most striking differences between the pre- and post-1995 periods. From the 1970s through 1995, productivity growth in goods-producing industries was generally greater than that in service-providing industries. However, since 1995, productivity growth in service-providing industries has exceeded the growth in goods-producing industries (such as manufacturing).

Given this difference, one of the most important insights into the recent period of productivity growth comes from understanding why service-sector productivity growth accelerated after a long period of slow growth. As discussed above, capital deepening and efficiency growth accounted for most of the acceleration of productivity growth for the U.S. economy as a whole over the last decade.

**Chart 2-3 Efficiency Growth Highest in Sectors That Made Large IT Investments in 1990s**  
The finance and business and the distribution sector made large IT investments in the 1990s and had large efficiency gains in 2000–2004.  
Annual average percent change, 2000–2004



Source: Corrado et al, "Modeling Aggregate Productivity at a Disaggregate Level: New Results for U.S. Sectors and Industries," Federal Reserve Board, July, 2006.

In examining productivity growth rates over the recent period, researchers have found it useful to characterize investments by whether they involve a purchase of IT equipment, which is usually defined as computer hardware, software, and telecommunications equipment. Box 2-1 discusses some of the potential mechanisms, such as intangible capital accumulation, through which IT capital leads to productivity improvements.

**Box 2-1: Intangible Capital and IT Investment**

While information technology clearly accounts for a sizable share of productivity growth since 2000, the mechanisms through which it induced this growth are not as clear. The assumption has been that since efficiency growth has been the largest contributor to productivity in this recent period, IT gains are embedded in this growing efficiency. However, hidden within these increases in efficiency may also be capital growth not captured in official measures.

Standard measures of capital primarily count physical capital, but businesses expend resources on many other activities that aim to increase the value of future output. Some examples are research and development spending, revamping a business's organization, advertising aimed at improving consumers' perceptions of a business's brand, or developing a secret recipe. These kinds of activities are often called intangible investment because they build up assets that are valuable to firms but are not easily measured.

Conceptually, these activities qualify as capital investment, but they are not currently included in official capital measures because they are hard to measure. Why does this matter when discussing productivity? Expanding the definition of capital by including intangibles would change the shares of the factors contributing to labor productivity growth, increasing the share attributed to capital deepening and reducing the share attributed to efficiency gains. This shift would not only call into question the finding that IT investment contributed to productivity mainly through efficiency gains, but would also help explain why productivity did not accelerate with early waves of IT investments. Indeed, it is consistent with the hypothesis that for businesses to take full advantage of their IT investments, they needed to develop innovative business practices. Only when they made intangible investments to complement their IT investments did productivity growth really take off.

The industries that produce IT equipment had particularly rapid efficiency growth, resulting in falling prices accompanied by rapid increases in the speed and power of IT equipment. These industries directly brought up the average rate of productivity growth for the economy, but their advances also had significant indirect effects by driving a surge in IT equipment investment in other industries. The increase in capital deepening in the 1990s was led by large investments in IT equipment, but productivity gains from these investments did not immediately emerge.

In the 1995 to 2000 period, industries with above-average investment in IT equipment had significantly larger increases in their productivity growth rates than did other industries. For example, the retail trade and financial services industries had much higher productivity growth over the 1995 to 2000 period than in the preceding period, and had well-above-average investment in IT equipment. Box 2-2 indicates that much of the retail trade productivity gains occurred because of supply chain improvements made possible by information technology. Research estimating the contribution of IT-related forces—including both productivity growth in IT-producing industries and the share of productivity growth accounted for by IT investment in other industries—shows that information technology accounted for more than half of productivity growth from 1995 to 2000.

**Box 2-2: Information Technology, the Supply Chain, and Productivity Growth in Retail Trade**

The retail trade sector shows how IT investment, innovation, competition, and flexible markets interact to affect productivity growth. Retailers have made heavy investments in information technology and have had rapid productivity growth, but changes in the way that retailers use information technology—both in their stores and with their suppliers—were necessary to generate this surge in productivity growth. The focus here is on two types of innovations: changes in the organization of the supply chain of consumer goods and changes in the way retailers organize store operations.

Manufacturers and retailers of consumer goods have increased their use of electronic data interchange, allowing manufacturers to help retailers manage inventories and avoid stockpiling and shortfalls. Electronic data interchange also allows for automatic ordering, billing, and payment. Retailers benefit from lower costs of carrying inventory and reduced resources spent managing it, and manufacturers benefit

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### **Box 2-2 — *continued***

from being able to smooth out production. Because these changes have enabled retailers to more reliably stock a wide variety of goods, consumers have benefited from increased product variety. Making these changes required an investment in IT equipment by manufacturers and retailers, and required them to change the way they exchanged information and interacted.

Large retailers also made internal changes that significantly increased productivity. One change was an increase in the scale of stores. Other important changes involved the use of information technology and improved management practices. Examples include an increased use of software to manage the flow of goods and staffing levels in stores, and more cross-training of employees to make better use of store labor. Rapid expansion of the largest firm put competitive pressure on other retailers, leading them to cut costs and, in many cases, to emulate the process improvements introduced by the industry leader.

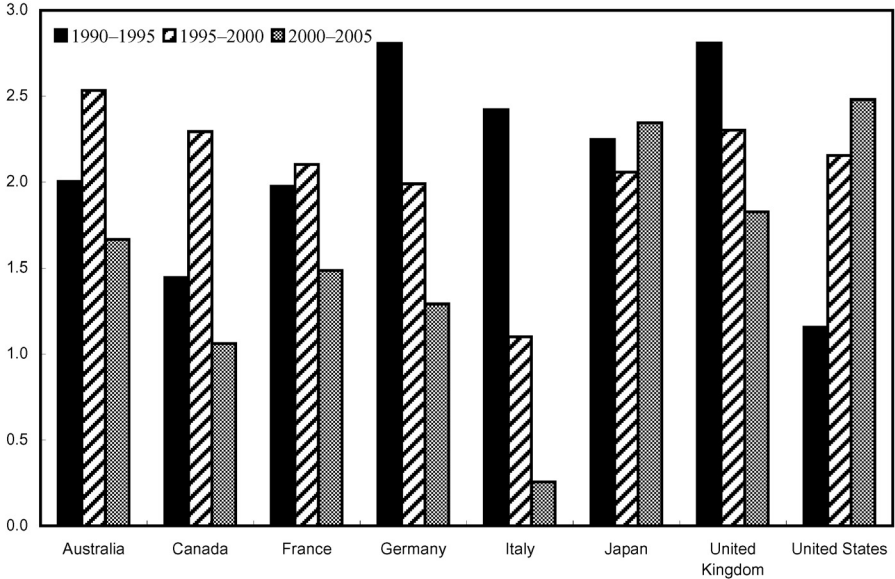
## **Why Has Productivity Growth Accelerated in the U.S. While Slowing in Other Countries?**

The United States has experienced the fastest acceleration of productivity growth among major industrialized countries since the early 1990s. Chart 2-4 shows that, after lagging behind most of the countries in the G7 between 1990 and 1995, the United States has been the country with the fastest growth in GDP per hour worked in the G7 between 2000 and 2005. Only the United States and Japan had faster productivity growth in the most recent period than they did in the early 1990s, and only the United States has shown consistent acceleration over this time period.

Since all of these countries have, in principle, approximately the same access to information and global markets, why have the other major industrialized countries not been able to post productivity gains as large as those in the United States and Japan? The major advances in this period appear to have come from opportunities that developed from the rapid advancement in information technology. While all developed countries had access to IT capital, the existing economic environment in the United States put it in position to quickly make the most of these opportunities. International openness to investment and trade combined with highly flexible and lightly regulated markets and an environment that fosters innovation appear to be at least part of the answer.

Chart 2-4 **Average Annual Productivity Growth Has Fallen for Most G7 Nations Since 1990**  
Only the United States has shown consistent increase in productivity growth over this period.

Annual percent change



Source: Organization for Economic Cooperation and Development.

## International Openness

As discussed earlier, capital deepening has played a significant role in U.S. productivity growth. Over the past 10 years, the United States is second only to Canada in its annual growth rate of real private investment. Real investment in the United States over this period increased at an annual rate of 5.1 percent, nearly double the average rate of the other G7 countries (excluding Canada). The United States has been able to accomplish this level of investment because of its open and transparent investment environment.

While capital deepening played an important role in the productivity gains experienced in the late 1990s, so did advances in information technology. To benefit from the IT boom, firms had to invest large amounts in computers, software, and employee training. From 1995 through 1999, U.S. investment in information-processing equipment and software increased at an average rate of around 20 percent per year, and total investment grew faster than in any other country in the G7. To help fund these investments, the United States received substantial flows of financial capital from abroad during this period. While the United States might have invested in IT capital without access to international financial markets, and while Europe may not have invested more even if it was more open to international capital flows, it is

almost certain that the United States was able to use its open investment environment to finance the increase in IT capital.

Access to international financial markets tends to lower borrowing costs and enable a country to increase capital investment rates without increasing domestic savings. This outcome would not be possible if businesses had access only to domestic financing.

International openness has also contributed in other ways to recent efficiency gains in the United States. Since the early 1990s, the United States has increased its openness to international trade. From the North American Free Trade Agreement (NAFTA) (signed into law in 1993) to the Trade Act of 2002 and the renewal of Trade Promotion Authority in the same year, the United States has worked to break down trade barriers. Lower trade barriers have in turn increased the level of international competition in product markets. Some U.S. companies have suffered from the increased competition; some have benefited. The increased competition forces firms to seek new ways of doing business to remain competitive, and because of this, international trade may contribute to growth in innovation.

## Flexible Labor Markets

Efficiency gains resulting from more flexible and competitive labor markets have been another important reason why the United States was able to benefit from recent shifts in technology. The United States ranks first among G7 countries in the World Bank's Rigidity of Employment Index, indicating very flexible labor markets relative to other G7 countries. Japan, for example, ranks fourth among G7 countries, while France ranks last. The index averages measures of the difficulty of hiring a new worker, restrictions on expanding or contracting the number of working hours, and the difficulty and expense of dismissing a worker. While other countries are tied with the United States on the latter two measures, the United States owes its first place rank to the ease with which American employers can hire new employees.

Flexible labor markets allow workers to flow to high-productivity and high-wage industries. Hiring and severance costs tend to increase unemployment by making firms reluctant to hire new workers. They encourage labor hoarding, a practice in which firms hold on to workers not currently needed for production in order to avoid the costs of hiring new workers when the firm's workforce needs to expand. Labor hoarding lowers the level of productivity and reduces the average growth rate of productivity, as firms find it more difficult to respond to innovations and shifts in demand.

Flexible labor markets improve productivity growth because they allow firms to more easily adjust the size and scope of their operations in response to economic developments. For example, after an increase in efficiency, a firm may become more competitive and decide to expand output and so need to



hire more workers. The firm may also wish to change the mix of workers it employs. Flexible labor markets allow these transitions to occur at a low cost.

## Low Costs of Starting a Business

Low costs of business entry with relatively few administrative hurdles have also contributed to greater efficiency gains in the United States. A recent study by the World Bank shows that the United States, at 5 days, ranks behind only Canada and Australia in terms of the number of days required to start a business, and has the fourth lowest administrative costs to start a new business. New businesses provide both a ready supply of new ideas and a source of competition that forces larger businesses to innovate. Both of these factors have likely given the United States an edge in taking advantage of new opportunities made possible by IT advances. As with flexible labor markets, the ease of starting a new business helps with the level and the growth rate of productivity. Over long periods of time, starting new businesses keeps the economic environment competitive, which spurs innovation and helps push inefficient firms out of the market place.

## Policy Implications

What can the United States do to promote further productivity growth? First, the most important way to encourage capital deepening is to maintain the smallest possible difference between the before-tax and the after-tax rates of return to investments. Capital deepening makes workers more productive and leads to higher wages in the long run. Making the tax cuts on capital gains and dividends permanent would help in this regard. Chapter 3 of this report discusses policy options affecting the taxation of capital.

Second, policies must encourage investment in skills. One way to do this is to keep the tax rates on wage income low. If individuals see little return to going to college, vocational school, or graduate school because of high tax rates on moderate- to high-wage earners, their incentives to invest in skill will be dampened. Chapter 3 further discusses how tax policy affects investment in skill. Strengthening K-12 education, reducing our dropout rates, and ensuring that all children receive high-quality education will increase the skills of our workforce and better prepare our citizens for further skill investment as adults. The President's efforts over the past several years to improve education and training with the No Child Left Behind Act, community college initiatives, and job training reforms will help. Furthermore, because learning begets learning, the returns should continue into the distant future.

Third, we must remain open to foreign investment. Openness to foreign capital has given the United States the flexibility it needs to deepen its capital

stock and improve its productivity without necessitating a corresponding increase in domestic savings. To maintain current growth rates we must keep pushing for freer trade, especially in the area of services, which has become a significant part of our economy. Chapter 8 of this report discusses policies to increase our international openness.

Fourth, we must encourage innovation and entrepreneurship. The President has outlined a competitiveness initiative that increases public investment in basic research—an important complement to private sector innovation—and strengthens math and science education to provide the skills needed for technological innovation.

## Conclusion

Maintaining a solid productivity growth rate is of great importance to maintaining and increasing U.S. standards of living. The surge in productivity growth since about 1995 has come from heavy business investment in information technology, accompanied by large efficiency gains from innovation and competition. The United States has gained more from rapid advances in information technology than the other major industrialized countries because its culture of entrepreneurship and its flexible markets for products, capital, and labor have allowed American businesses to make the most of these changes.